

FIG. 1

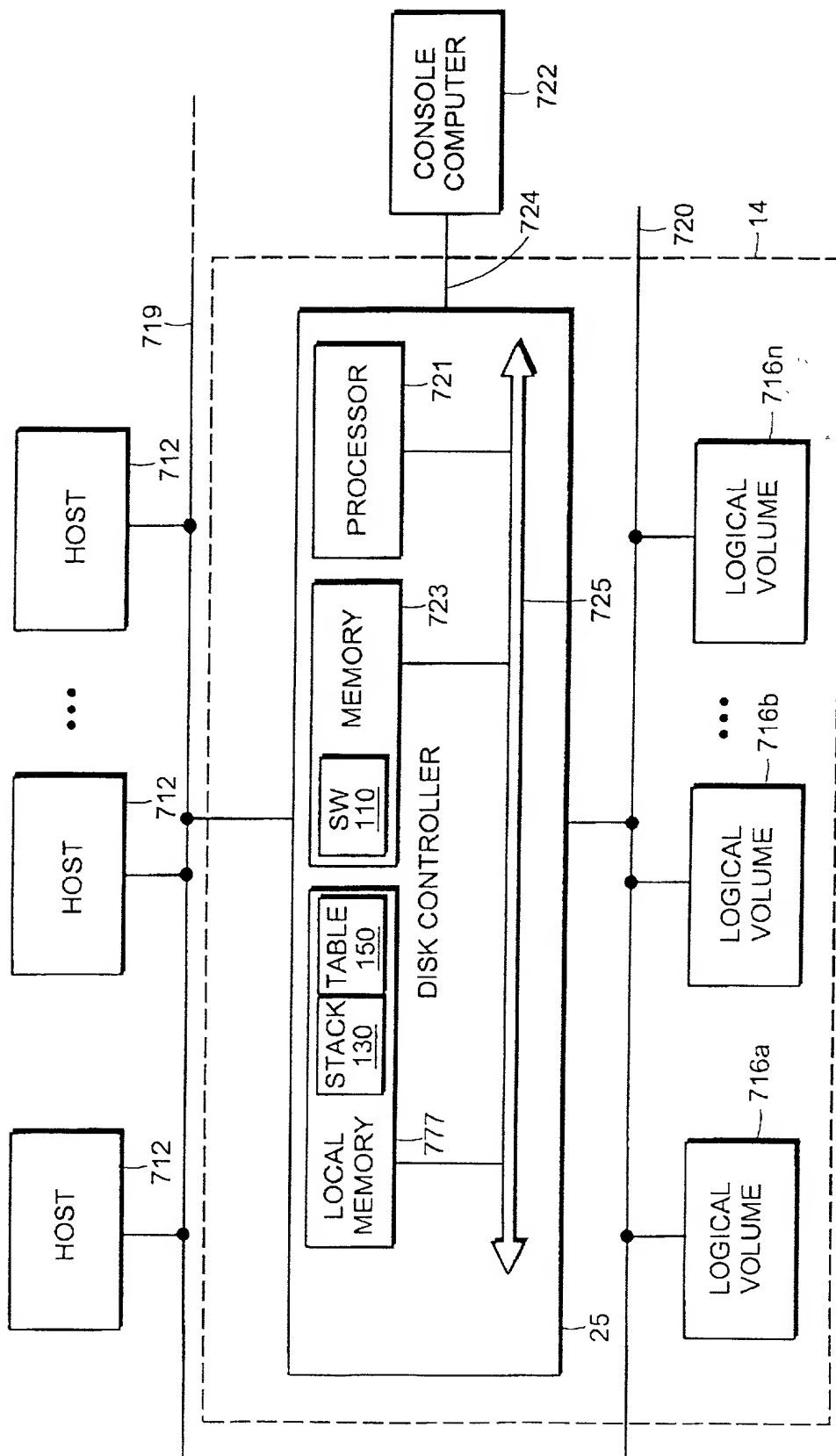


FIG. 2

```

LOCATE AT (PROFILE_DATA_area)
EXTERN T SYMPROF_TABLE_ENTRY symprof_stat_table [SYMPROF_MAX_TABLE_ENTRIES];
END LOCATION

```

```

LOCATE AT (LCLMM_SYM_PROFILER)
EXTERN T PROFILER_SETUP_RECORD profilerSetupTable [PROFILER_RANGES_Q];
EXTERN TCO PROFILER_RUNTIME_INFO runtimeInfo;
EXTERN ULONG symprof_stack_index; /* index into the profiler stack frame */
EXTERN TCO SYMPROF_STACK_FRAME symprof_stack_base [MAX_NUMBER_OF_SYM_PROF_STACK_FRAMES];
END LOCATION

```

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```

typedef enum
(
    PROFILER_MODE_UNDEFINED = 0,
    PROFILER_MODE_PROFILING = 1,
    PROFILER_MODE_TRACING = 2,
    PROFILER_MODE_ONCE = 3
) T_PROFILER_MODE;

```

FIG. 3

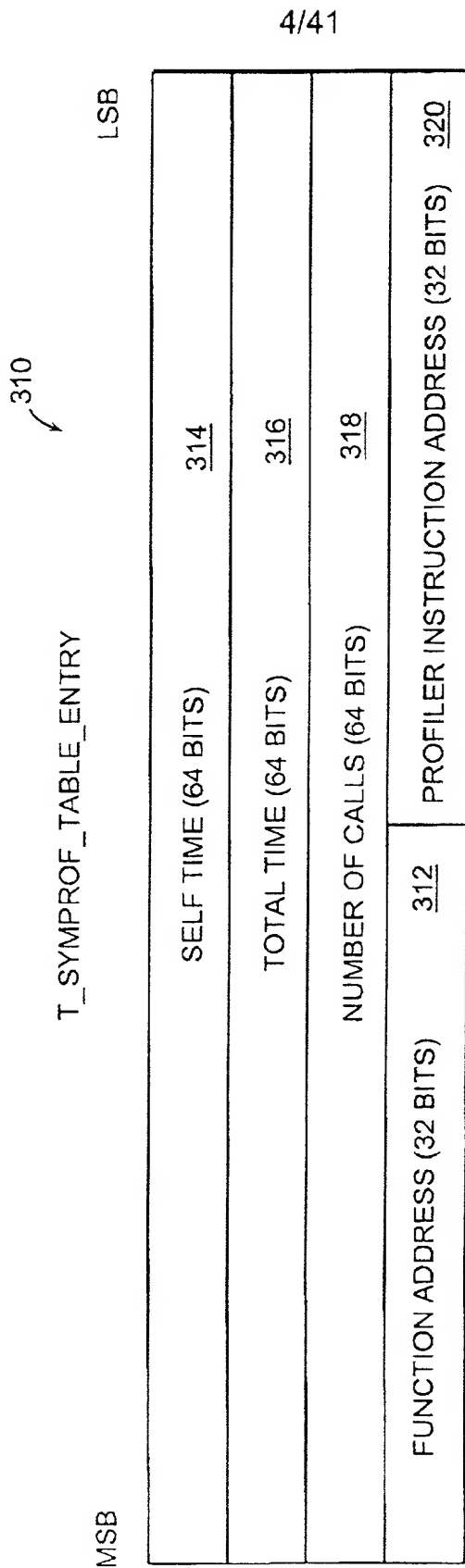


FIG. 4

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T_SYMPROF_STACK_FRAME

	MSB		LSB
0x00	RETURN ADDRESS <u>412</u>		TABLE ENTRY INDEX <u>414</u>
0x08	ENTRY TIME <u>416</u>		
0x10	RE-ENTRY TIME <u>418</u>		
0x18	SELF TIME <u>420</u>		

FIG. 5

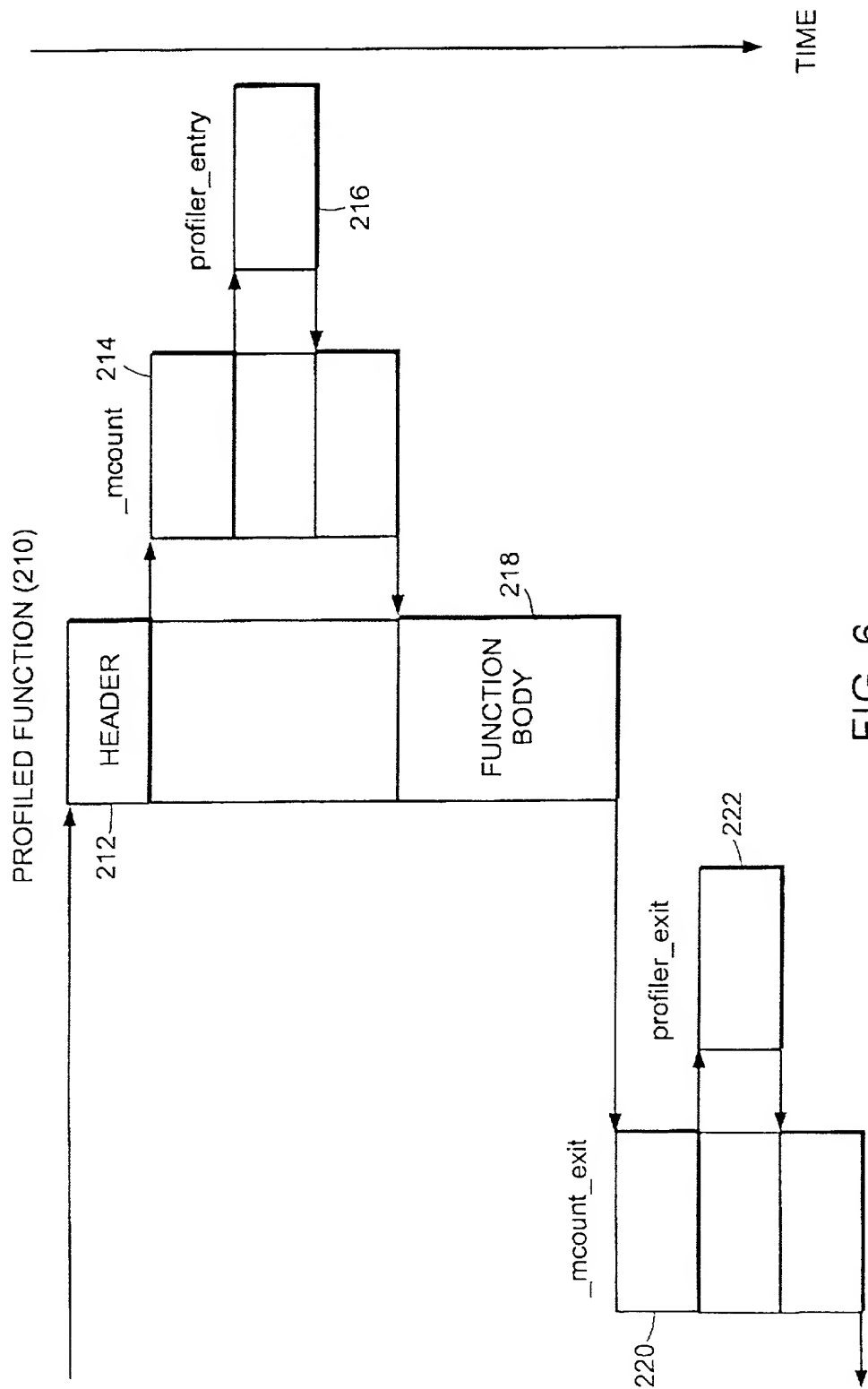


FIG. 7A
FIG. 7B

FIG. 7

Original program code

```
BOOLEAN update_restored_ckd_id_table(T_DV_REC *p_dv)
{
    stwu %r1, -16(%r1)
    mflr %r0
    stw %r31, 12(%r1)
    stw %r0, 20(%r1)
    mr %r31, %r3
```

FIG. 7A

With Profiler code:

```

BOOLEAN update_restored_ckd_id_table(T_DV_REC *p_dv)
{
    stwu %r1,-16(%r1)
    mflr %r0
    stw %r31,12(%r1)
    stw %r0,20(%r1)
    .section ".bss1"
    .align 2
    .long 0
    .long 0
    .long 0
    .long 0
    .long 0
    .long 0
    .long 0
    .long 0
    .long 0
    .section ".text"
    b .+8 <-- Replaced by "bla_mcount" when profiling enabled
    .long .LP0
    mr %r31,%r3

```

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FIG. 7B

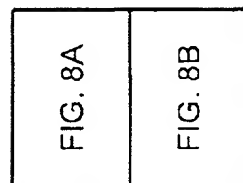


FIG. 8

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```

void profiler_entry (T_SYMPROF_TABLE_ENTRY* self_entry, ULONG* params_p)
{
    UINT64 time_now = getTimeBase(); /* Take a snapshot of the current time */

    /* Stop the profiler if we are over the time limit */
    if (runtimeInfo.timeLimit &&
        ((cu_timer - runtimeInfo.startTime) > runtimeInfo.timeLimit))
    {
        /* Over the time limit - stop the profiler */
        BIT_CLEAR(B_SYMPROF_ON, runtimeInfo.flags);
        runtimeInfo.stopTime = cu_timer;
    }

    /* Start the timer for the function being profiled (self) and reset the
       self total time */

    symprof_stack_base [symprof_stack_index].entry_time = time_now;
    symprof_stack_base [symprof_stack_index].reentry_time = time_now;
    symprof_stack_base [symprof_stack_index].self_time = 0;

    /* Set the index to which this stack frame refers */
    symprof_stack_base [symprof_stack_index].table_entry = (ULONG) self_entry;

```

FIG. 8A

```

/* Stop the timer of the parent function (parent) */
if (symprof_stack_index != 0)
{
    /* We are not at top level of the profiler stack - compute the total
       time spent in the parent since last reentry to the parent */

    symprof_stack_base[symprof_stack_index-1].self_time +=
        time_now - symprof_stack_base[symprof_stack_index-1].reentry_time;
}

/* Increment self counter */
self_entry->calls++;

/* Push self stack frame on profiler stack, check for overflow */
if (++symprof_stack_index >= MAX_NUMBER_OF_SYM_PROF_STACK_FRAMES)
{
    /* Profiler stack overflow: disable profiling */
    BIT_CLEAR(B_SYMPROF_ON, runtimeInfo.flags);
    runtimeInfo.stopTime = cu_timer;
}

if (runtimeInfo.mode == PROFILER_MODE_TRACING)
{
    traceRoutineEntry (self_entry->functionAddr, params_p);
}
}

```

FIG. 8B

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FIG. 9A
FIG. 9B

FIG. 9

```

void profiler_exit (ULONG* params_p)
{
    T_SYMPROF_TABLE_ENTRY* self_entry;
    UINT64 time_now = getTimeBase (); /* Take a snapshot of the current time */

    /* Pop the calling function's stack frame from profiler's stack */
    symprof_stack_index--;

    /* Update the re-entry time of the parent function */
    if (symprof_stack_index != 0)
    {
        /* We are not at top level of the profiler's stack - store the reentry
           time of the parent function */
        symprof_stack_base[symprof_stack_index-1].reentry_time = time_now;
    }

    /* Don't update the entry if the profiler is off */
    if (BIT_IS_CLEAR(B_SYMPROF_ON, runtimeInfo.flags))
    {
        return;
    }
}

```

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FIG. 9A

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```

/* Update the current function's profiler table entry */
self_entry = (T_SYMPROF_TABLE_ENTRY *)
    symprof_stack_base[symprof_stack_index].table_entry;

self_entry->self_time +=
    TimeBase2Micros(time_now -
        symprof_stack_base[symprof_stack_index].reentry_time +
        symprof_stack_base[symprof_stack_index].self_time);

self_entry->total_time +=
    TimeBase2Micros(time_now -
        symprof_stack_base[symprof_stack_index].entry_time);

if (runtimeInfo.mode == PROFILER_MODE_TRACING)
{
    traceRoutineExit (self_entry->functionAddr, params_p);
}

if (runtimeInfo.mode == PROFILER_MODE_ONCE)
{
    /* Disable profiling by replacing "bla_mcount" with "br .+8" */
    insertInstruction ((ULONG *)self_entry->profilerInstructionAddr,
        PPC_B_LOCATION_PLUS_8_INSTR);
}
}

```

FIG. 9B

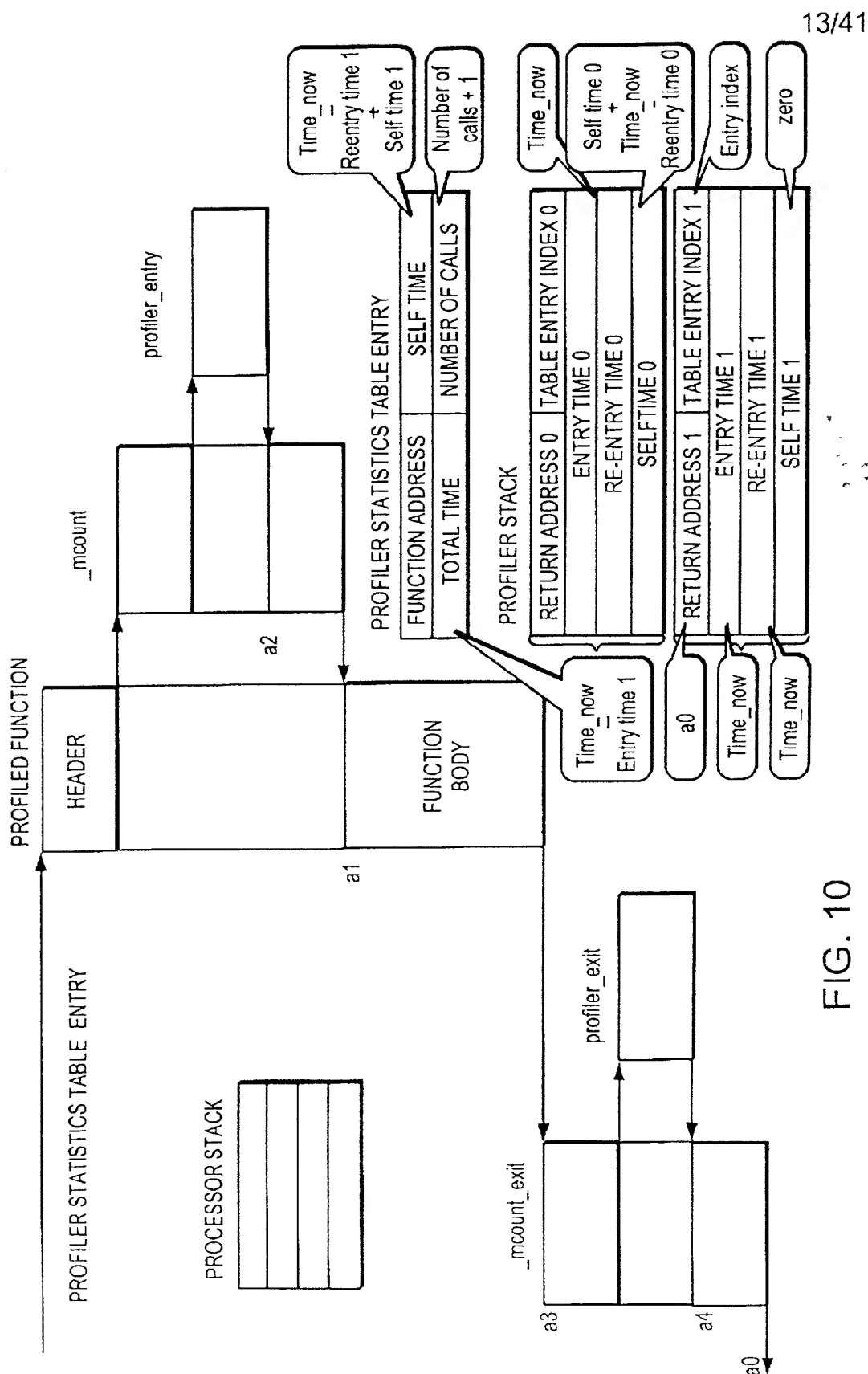


FIG. 10

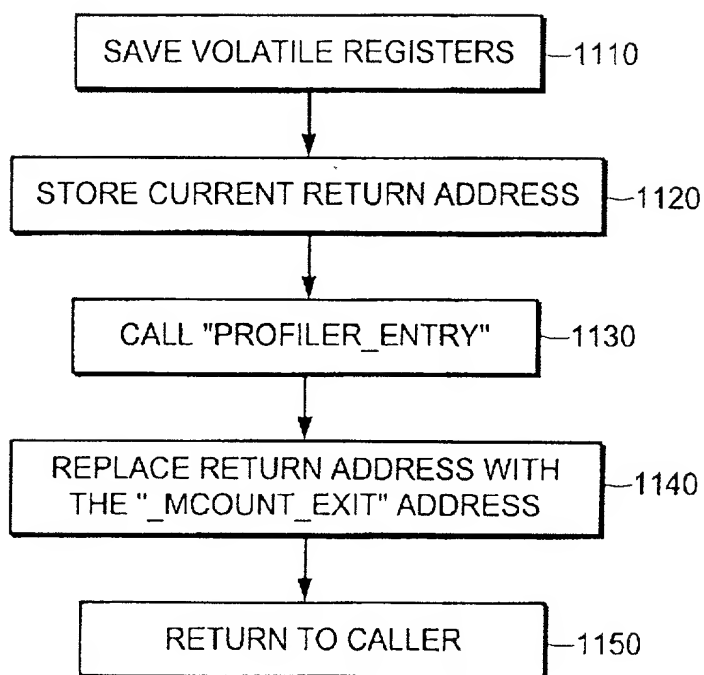


FIG. 11

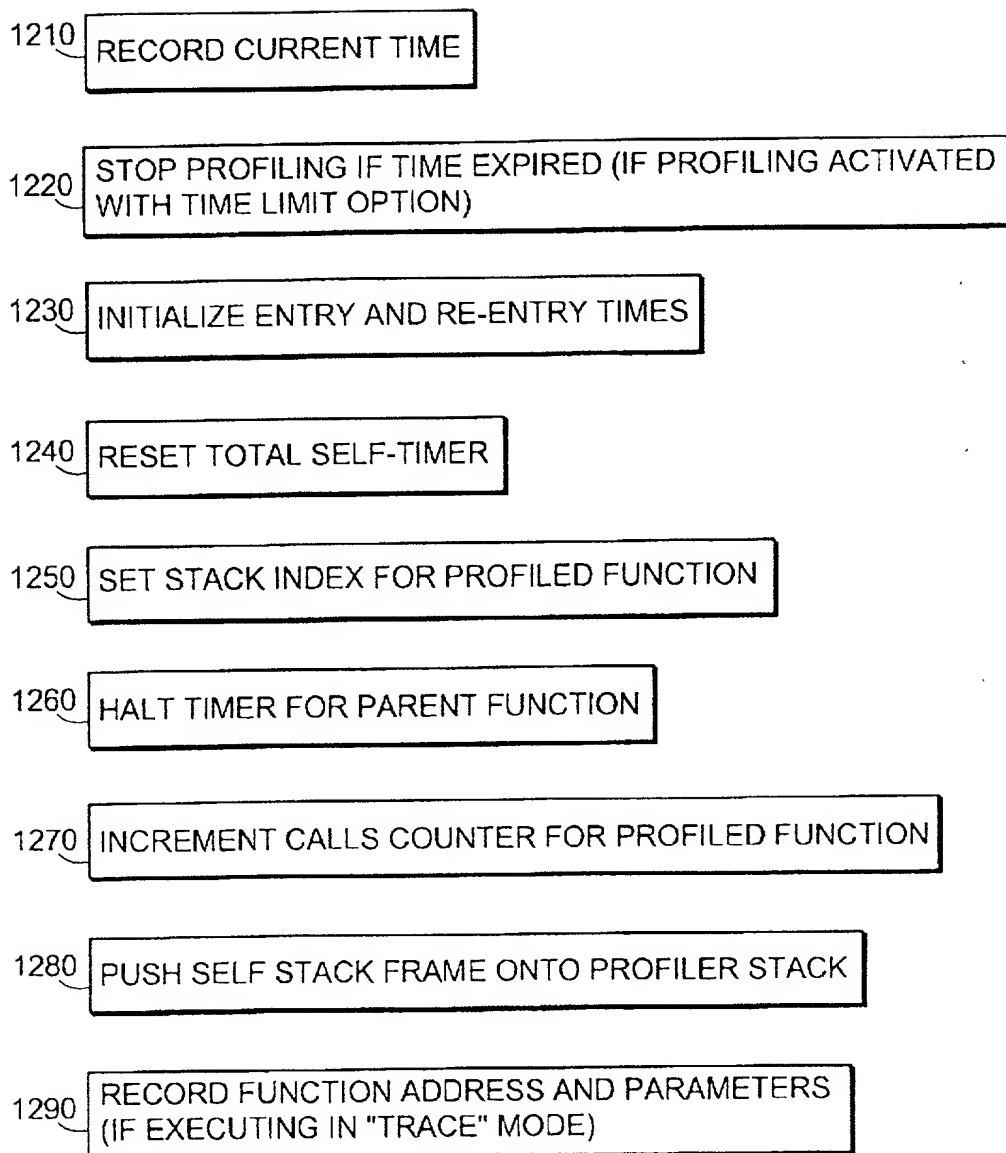


FIG. 12

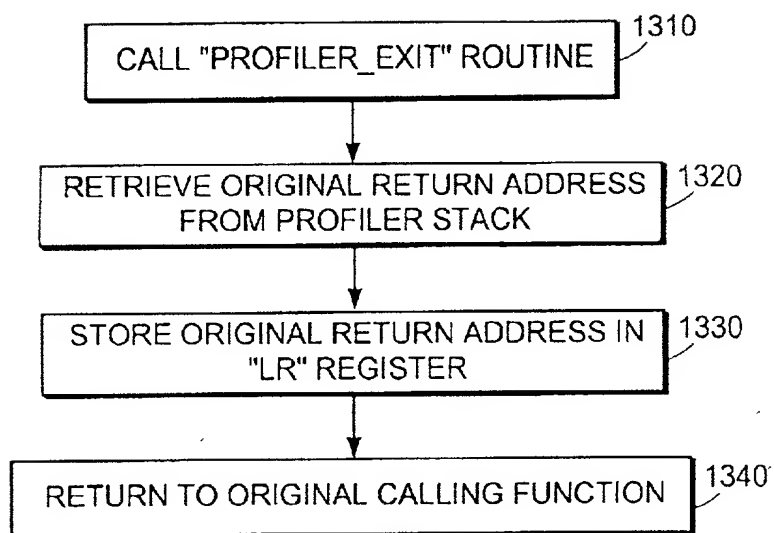


FIG. 13

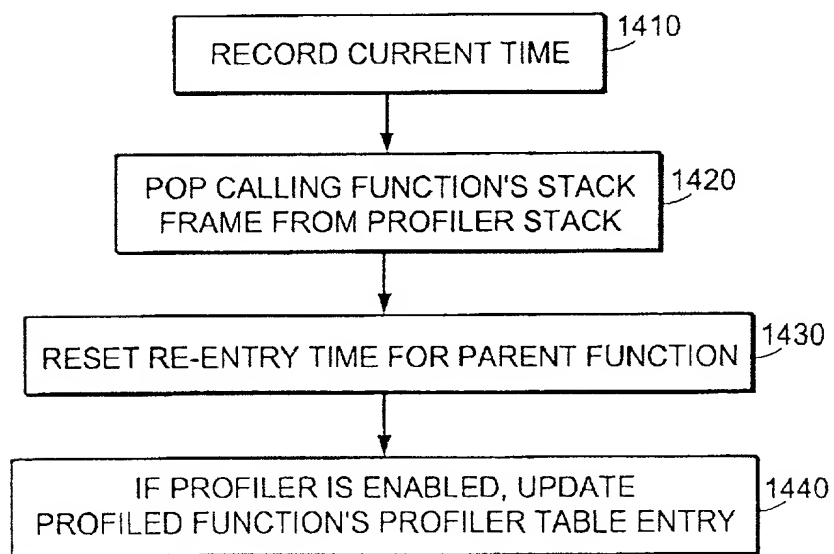


FIG. 14

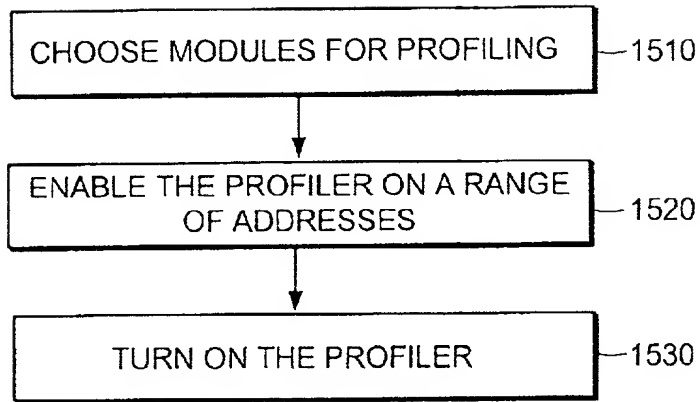


FIG. 15

UTILITY 83 -- Sym-Profiler : TIME: SEP/30/01 18:13:37

83, [HELP | AAAA], [STUP | EXEC | DISP] - Display help page
STUP - Setup
EXEC - Runtime control
DISP - Display statistics

P in prompt - Profiler in ON
Event trace message: 0xd3

FIG. 16A

UTILITY 83 -- Sym-Profiler : TIME: SEP/30/01 18:16:4

Profiler Setup

83,DEF,<range number>,<start-addr>,<end-addr>,<flags>
 Add to <flags>: 0x1 - symbolic addr range
 0x2 - multi-module range, p6 and p7 = name of end module
 83,IC | D | E|,<ranges bitmap> - Clear, Disable, Enable ranges per bitmap
 83,EE
 - Restore setup from NVD
 83,DD,<start range>,<flags> - Display profiler setup
 Add to <flags>: 0x1 - display from NVD
 83,DRAW,<ranges bitmap>,<flags> - Display profiler setup in raw mode
 Add to <flags>: 0x1 - display from NVD

FIG. 16B

UTILITY 83 -- Sym-Profiler : TIME: SEP/30/01 18:19:0

83,CA	Profiler Execution
83,1,<mode>,<time>]	- Clear profiler statistics
<mode>	- Start profiling (optionally stop after <time> seconds)
	TRAC - Tracing
	PROF - Profiling
	ONCE - Do once then disable (per function)
83,0	- Stop profiling

FIG. 16C

UTILITY 83 -- Sym-Profiler : TIME: SEP/30/01 18:20:1

____ Profiler Display _____

83,A,<skip>,<lines>,<key>,<order> - Display statistics
 <skip> - Number of entries to skip before starting display
 <lines> - Number of lines to display in page (default is 16)

<key>='CALL' - Rank statistics by number of calls
 'SELF' - Rank statistics by function time alone (no descendant time)
 'TOTL' - Rank statistics by total function time
 'SEAV' - Rank statistics by function time (average)
 'TOAV' - Rank statistics by total function time (average)
 <order>= [ASCE | DESC] - Rank statistics in ascending/descending order

83,AF,0,<function address> - Display statistics for one function
 83,AF,1,<module-name>,<module-name>,<offset> specify function as
 module+offset

83,AF,1,<module-name>,<module-name>,1 - Display statistics for all functions
 in module

83,AA,<ranges bitmap> - Display all functions in range
 83,A0,<ranges bitmap> - Display functions in range which were not called
 83,A1,<ranges bitmap> - Display functions in range which were called

FIG. 16D

DA- 16a : S5 IMPL MONITOR > 83,1,50524F4

UTILITY 83 -- Sym-Profiler : TIME: OCT/01/01 11:06:59

Profiler is ON, Mode: Profiling, Setup time: OCT/01/01 11:04:02

No.	Range		Found	Functions		Statistics table	
	Start	End		First	Last	First	Last
*01.	unzip_ld+00000	100000 sfs_vnop+133e8	500000	1035	00260a5c	004c5088	008d0000 008d8140

Runtime information:

Start time: OCT/01/01 11:06:59; Stop time: _____

Runtime limit: No limit

FIG. 17

DA- 16a : PS5 IMPL MONITOR > 83,0

UTILITY 83 -- Sym-Profiler : TIME: OCT/01/01 11:01:11

Profiler: OFF

Start time: 10:56:01 OCT/01/01 0a587783

Stop Time: 11:01:11 OCT/01/01 0a5879ee

Run Time : 0d 00h 05m 09s

FIG. 18

DA- 16a : PS5 IMPL MONITOR > 83,A

UTILITY 83 -- Sym-Profiler : TIME: OCT/01/01 11:14:37

Profiler: ON, MODE: Profiling

Start time: 11:06:59 OCT/01/01 0a587ca6

Run Time : 0d 00h 07m 38s

Routine Module/Offset	Address	Number of Drawings	Time (micros)		Average time (micros)		% time	
			Self	Total	Self	Total	Self	Total
thermal_+00170	49e22c	1	87911	87911	87911	87911	0	0
thermal_+001a0	49e25c	4	57332	57332	14333	14333	0	0
thermal_+00004	49e0c0	3	483	483	161	161	0	0

Min stack pointer = 0082fba8 at 0049e0c0, stack available = 0002fba8 bytes

FIG. 19A

FIG. 19B-1
FIG. 19B-2

FIG. 19B

FIG. 19B-1

UTILITY 83 -- Sym-Profiler : TIME: OCT/01/01 14:54:30

Profiler: ON, MODE: Profiling

Start time: 14:54:23 OCT/01/01 0a58e73e

Run Time : 0d 00h 00m 07s

Routine Module/Offset	Address	Number of Drawings	Time (micros)		Average time (micros)		% time	
			Self	Total	Self	Total	Self	Total
daschedu+01cc0	3641d0	44501	226182	5145138	5	115	3	73
daschedu+00ad8	362fe8	32752	98552	3948230	3	120	1	56
dawrites+00004	267ec0	32752	1593660	3849616	48	117	22	54
dawrites+016c0	26957c	127683	1400634	2053441	10	16	20	29
dawrites+012d0	26918c	488521	515448	605265	1	1	7	8
daschedu+01048	363558	46165	402229	467912	8	10	5	6
daschedu+01598	363aa8	44501	205113	455331	4	10	2	6
daschedu+007dc	362cec	11804	19880	447482	1	37	0	6
daprefch+03788	2641d0	11804	23263	429399	1	36	0	6
daprefch+01d0c	262754	11804	74382	376237	6	31	1	5
daprefch+01fa8	2629f0	46916	283656	309941	6	6	4	4
daschedu+00004	362514	44501	173907	205722	3	4	2	2
da_utils+02858	2f1468	44339	163917	163917	3	3	2	2
dawrites+00dd4	268c90	133836	133836	133836	1	1	1	1
dawrites+00728	2685e4	41789	124541	125498	2	3	1	1
daschedu+00e04	363314	2521	109413	109413	43	43	1	1

Min stack pointer = 0082f260 at 0026c4f4, stack available = 0002f260 bytes

DA- 2a : P.sS5 DISK SUBSYSTEM:>

Set-Up-Time: OCT/01/01 14:56:17 Stop-Trigger: FFFFFFFF Phase: COLLECT
Collect-Time: OCT/01/01 14:56:17 GM Reject: 0(0)/0
Util 97 Info - Setup Time: OCT/01/01 13:22:25

DONE.

DA- 2a : P.sS5 DISK SUBSYSTEM:>

FIG. 19B-2

Util_end: 00000000 msgid=552905
10/01/01 15:22:06 15b -> PC (Unknown)

Util_end: 00000000 msgid=CEFABEBA
10/01/01 15:22:06 01a -> PC (Unknown)

Util_end: 00000000 msgid=CEFABEBA
10/01/01 15:22:06 15a -> PC (Unknown)

Util_end: 00000000 msgid=CEFABEBA
10/01/01 15:22:06 01b -> PC (Unknown)

Util_end: 00000000 msgid=CEFABEBA
10/01/01 15:22:06 16a -> PC (Unknown)

Util_end: 00000000 msgid=CEFABEBA
10/01/01 15:22:06 16d -> PC (Unknown)

Util_end: 00000000 msgid=CEFABEBA
10/01/01 15:22:06 16b -> PC (Unknown)

Util_end: 00000000 msgid=CEFABEBA
10/01/01 15:22:06 16c -> PC (Unknown)

Util_end: 00000000 msgid=CEFABEBA
10/01/01 15:23:03 02b -> PC (Unknown)

OCT/01/01 14:57:17 CONTROL STORE TEST...01 add(00080000)PASSED.

DA- 2b : .sS5 DISK SUBSYSTEM:>
10/01/01 15:23:20 01b -> PC (Unknown)

OCT/01/01 14:57:34 CONTROL STORE TEST...01 add(00080000)PASSED.

DA- 1b : .sS5 DISK SUBSYSTEM:>
10/01/01 15:24:03 01a -> PC (Unknown)

FIG. 19C

FIG. 19D-1
FIG. 19D-2

FIG. 19D

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DA- 1a : .sS5 DISK SUBSYSTEM:>
 10/01/01 15:26:48 02b -> PC (Unknown)
 ptErrorResp [85.5F16.06] at 10/01/2001 3:26:48 PM
 10/01/01 15:26:48 01a -> PC (Unknown)

DA- 1a : .sS5 DISK SUBSYSTEM:>
 10/01/01 15:30:09 Manual Inlines command sent: 83,A
 10/01/01 15:30:09 PC (INLINES) -> 02a,,

Command to dir 02a: [83,A,] msgid=552A05
 10/01/01 15:30:09 02a -> PC (INLINES)

UTILITY 83 -- Sym-Profiler : TIME: OCT/01/01 15:04:23

Profiler: ON, MODE: Profiling

Start time: 14:54:23 OCT/01/01 0a58e73e
 Run Time : 0d 00h 10m 00s

FIG. 19D-1

Routine Module/Offset	Address	Number of Drawings	Time (micros)		Average time (micros)		% time	
			Self	Total	Self	Total	Self	Total
daschedu+01cc0	3641d0	2522952	12991240	329169241	5	130	2	54
daschedu+00ad8	362fe8	2055489	6183238	262200235	3	127	1	43
dawrites+00004	267ec0	2055489	109371204	256003627	53	124	18	42
dawrites+016c0	26957c	6998173	85742065	126349753	12	18	14	21
dawrites+012d0	26918c	31979335	30528363	34969248	0	1	5	5
daschedu+01048	363558	2685627	24248920	28323741	9	10	4	4
daschedu+01598	363aa8	2522952	11494217	26585146	4	10	1	4
da_copyt+02970	37b428	2652	35059	14419079	13	5437	0	2
daschedu+007dc	362cec	387932	702492	13111048	1	33	0	2
daschedu+00004	362514	2522952	10933652	12611157	4	4	1	2
daprefch+03788	2641d0	387932	820965	12478041	2	32	0	2
daprefch+01d0c	262754	387932	2333514	11458184	6	29	0	1
daschedu+00828	362d38	54643	363880	10799259	6	197	0	1
daschedu+00a10	362f20	7919	812005	10421421	102	1316	0	1

FIG. 19D-2

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da_rtask+00004 373224 | 3503 | 50487 | 9518913 | 14 | 2717 | 0 | 1 |
dawrites+00728 2685e4 | 2723405 | 9344426 | 9422713 | 3 | 3 | 1 | 1 |
Min stack pointer = 00825370 at 002a6450, stack available = 00025370 bytes

DA- 2a : P.sS5 DISK SUBSYSTEM:>
Util_end: 00000000 msgid=552A05
10/01/01 15:31:47 15a -> PC (Unknown)

OCT/01/01 15:06:01 CONTROL STORE TEST...01 add(00080000)PASSED.
10/01/01 15:32:03 16a -> PC (Unknown)

OCT/01/01 15:06:17 CONTROL STORE TEST...01 add(00080000)PASSED.
10/01/01 15:33:55 15b -> PC (Unknown)

OCT/01/01 15:08:09 CONTROL STORE TEST...01 add(00080000)PASSED.
10/01/01 15:34:01 02a -> PC (INLINE)
ptErrorResp [85.5F16.06] at 10/01/2001 3:34:01 PM
10/01/01 15:34:01 01a -> PC (Unknown)

DA- 1a : .sS5 DISK SUBSYSTEM:>
10/01/01 15:34:17 16b -> PC (Unknown)

OCT/01/01 15:08:31 CONTROL STORE TEST...01 add(00080000)PASSED.
10/01/01 15:34:58 Closing Inlines
10/01/01 15:35:03 Opening Inlines, user: , group: PC group
10/01/01 15:35:17 Manual Inlines command sent: 83,AAAA
10/01/01 15:35:17 PC (INLINE) -> 01a,,

Command to dir 01a: [83,AAAA,] msgid=552C05
10/01/01 15:35:17 01a -> PC (INLINE)

UTILITY 83 -- Sym-Profiler : TIME: OCT/01/01 15:09:31

83, [HELP | AAAA], [STUP | EXEC | DISP] - Display help page
STUP - Setup

FIG. 19E

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EXEC - Runtime control
DISP - Display statistics

P in prompt - Profiler in ON
Event trace message: 0xd3

DA- 1a : .sS5 DISK SUBSYSTEM:>
Util_end: 00000000 msgid=552C05
10/01/01 15:35:22 Manual Inlines command sent: .
10/01/01 15:35:22 PC (INLINES) -> 01b,,

Command to dir 01b: . msgid=552D05
10/01/01 15:35:22 01b -> PC (INLINES)

NON HEX CHAR

DA- 1b : .sS5 DISK SUBSYSTEM:>
10/01/01 15:35:26 Manual Inlines command sent: .
10/01/01 15:35:26 PC (INLINES) -> 02a,,

Command to dir 02a: . msgid=552E05
10/01/01 15:35:26 02a -> PC (INLINES)

NON HEX CHAR

DA- 2a : P.sS5 DISK SUBSYSTEM:>
10/01/01 15:35:31 Manual Inlines command sent: 83,A
10/01/01 15:35:31 PC (INLINES) -> 02a,,

Command to dir 02a: [83,A,] msgid=552F05
10/01/01 15:35:32 02a -> PC (INLINES)

UTILITY 83 -- Sym-Profiler : TIME: OCT/01/01 15:09:45

Profiler: ON, MODE: Profiling

FIG. 19F

Start time: 14:54:23 OCT/01/01 0a58e73e
Run Time : 0d 00h 15m 22s

Routine Module/Offset	Address	Number of Drawings	Time (micros)		Average time (micros)		% time	
			Self	Total	Self	Total	Self	Total
daschedu+01cc0	3641d0	4048572	21154575	494195505	5	122	2	53
daschedu+00ad8	362fe8	3291389	9902877	385479049	3	117	1	41
dawrites+00004	267ec0	3291389	158197598	375574540	48	114	17	40
dawrites+016c0	26957c	9793496	127646078	187230604	13	19	13	20
dawrites+012d0	26918c	47216195	44602356	51039823	0	1	4	5
daschedu+01048	363558	4491138	40201730	46996117	8	10	4	5
daschedu+01598	363aa8	4048572	18782025	42846503	4	10	2	4
da_copyt+02970	37b428	4805	80589	21817204	16	4540	0	2
daschedu+007dc	362cec	746474	1320046	21643679	1	28	0	2
daprefch+03788	2641d0	746474	1538576	20458191	2	27	0	2
daschedu+00004	362514	4048572	17360936	19983269	4	4	1	2
daprefch+01d0c	262754	746474	3842503	18513306	5	24	0	2
daschedu+00828	362d38	94399	677156	17337392	7	183	0	1
da_copyt+020e4	37ab9c	4805	1255412	17013818	261	3540	0	1
daschedu+00a10	362f20	15427	1584969	16634358	102	1078	0	1
da_rtask+00004	373224	11742	133494	16066053	11	1368	0	1

Min stack pointer = 00823048 at 0049f394, stack available = 00023048 bytes

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DA- 2a : P.SS5 DISK SUBSYSTEM:>

FIG. 19G

Profiler: ON, MODE: Profiling

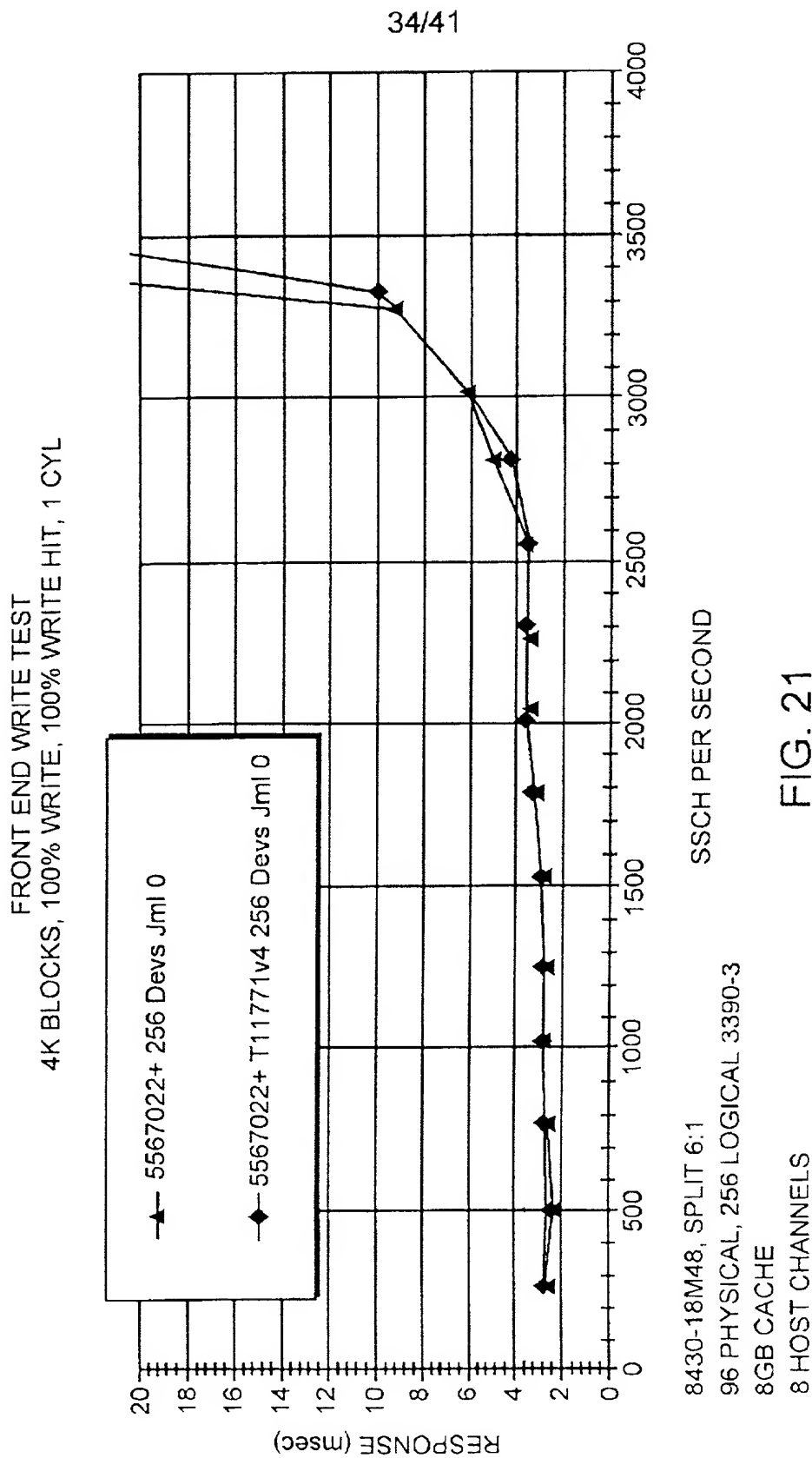
Start time: 14:54:23 OCT/01/01 0a58e73e

Run Time : 0d 00h 35m 31s

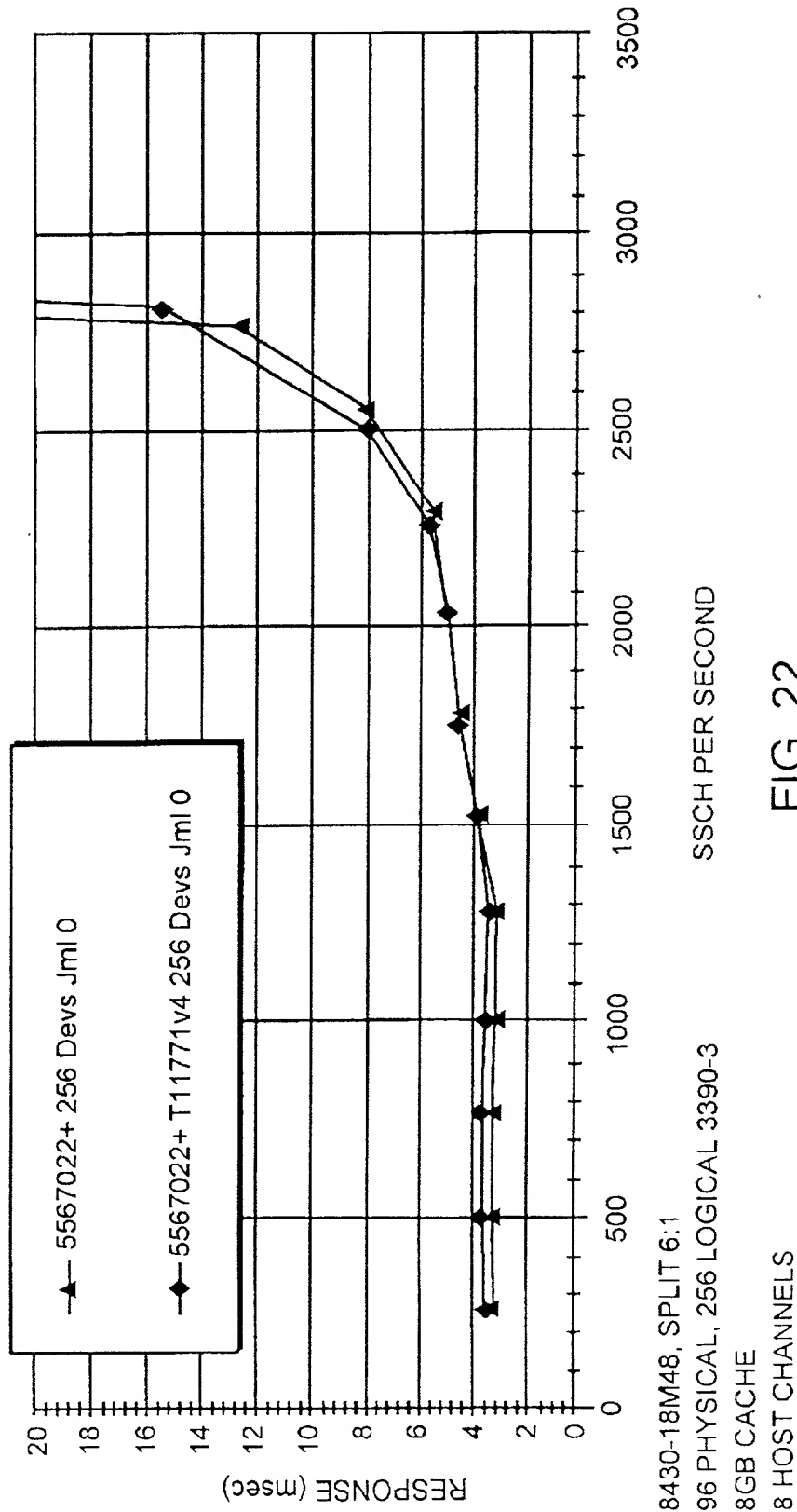
Routine Module/Offset Address	Number of Drawings	Time (micros)		Average time (micros)		% time	
		Self	Total	Self	Total	Self	Total
dawrites+00004 267ec0	8159810	379921296	906208848	46	111	17	42
dawrites+016c0 26957c	23194433	311286293	454524217	13	19	14	21
dawrites+012d0 26918c	113817075	107355424	123512544	0	1	5	5
daschedu+01048 363558	10837699	97770758	114282199	9	10	4	5
daschedu+01cc0 3641d0	9992748	51666137	1170386199	5	117	2	54
daschedu+01598 363aa8	9992748	46125615	103420081	4	10	2	4
daschedu+00004 362514	9992748	41495305	47383227	4	4	1	2
da_utils+02858 2f1468	9958730	37412992	37412992	3	3	1	1
dawrites+00728 2685e4	10299487	33491913	33763773	3	3	1	1
daschedu+00e04 363314	655745	28488210	28488210	43	43	1	1
daprefch+01fa8 2629f0	4101228	24844129	27249016	6	6	1	1
daschedu+00ad8 362fe8	8159810	24544745	930763270	3	114	1	43
da_copyt+00100 378bb8	10118	23769100	25413369	2349	2511	1	1
dawrites+00dd4 268c90	23484807	23485140	23485140	1	1	1	1
idle_stt+00080 394434	10995564	21948672	21948761	1	1	1	1
cache_rt+03f04 26e8e4	2313095	19836710	23451890	8	10	0	1

Min stack pointer = 00823048 at 0049f394, stack available = 00023048 bytes

FIG. 20



BACK END WRITE TEST
4K BLOCKS, 100% WRITE, 100% WRITE HIT



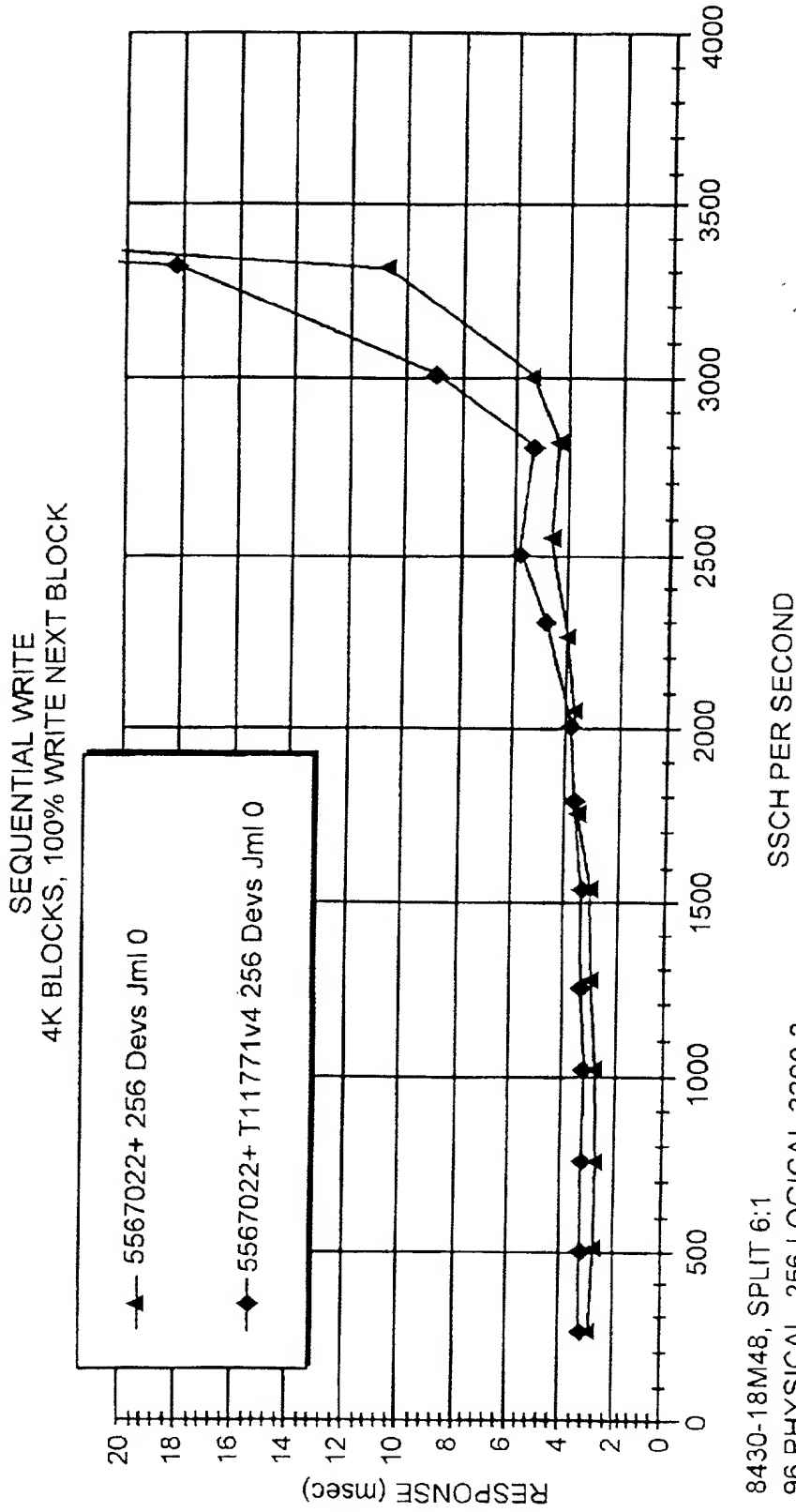
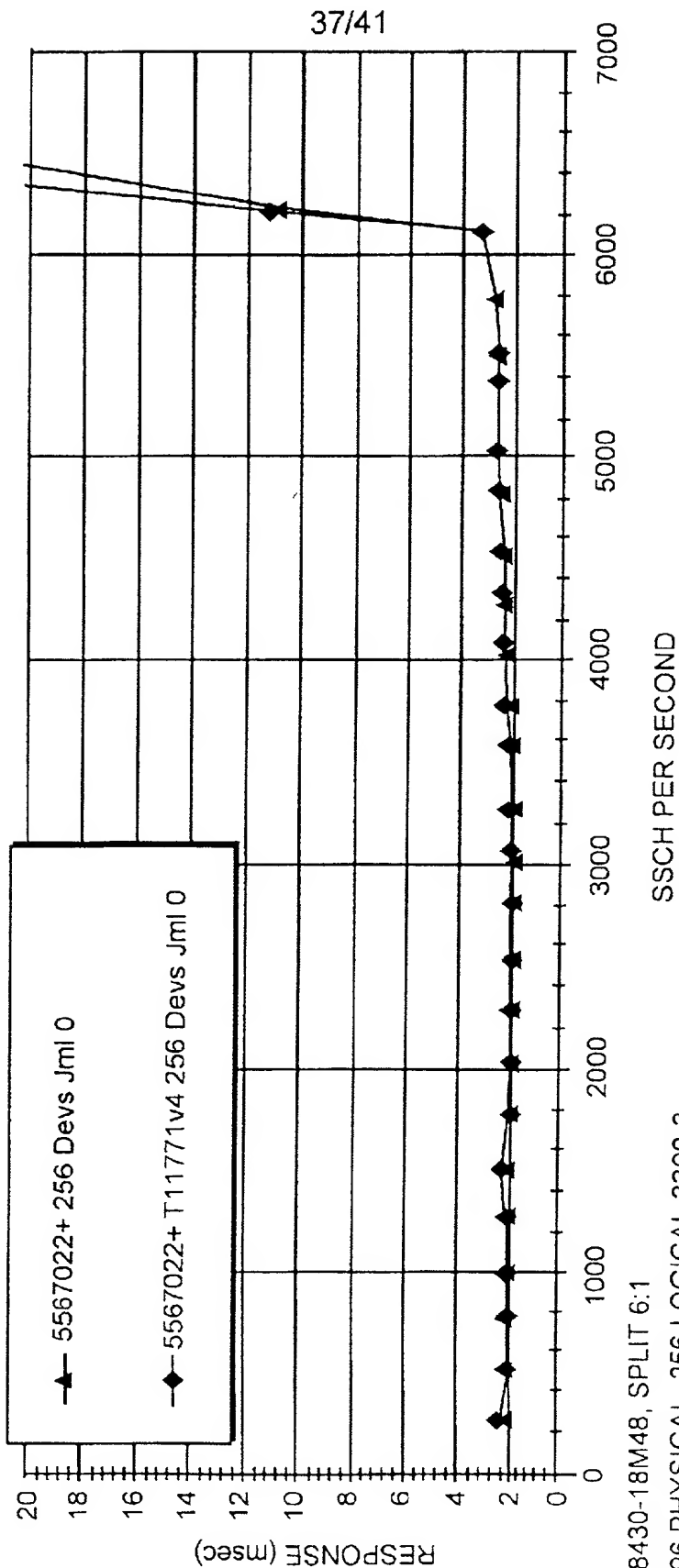


FIG. 23

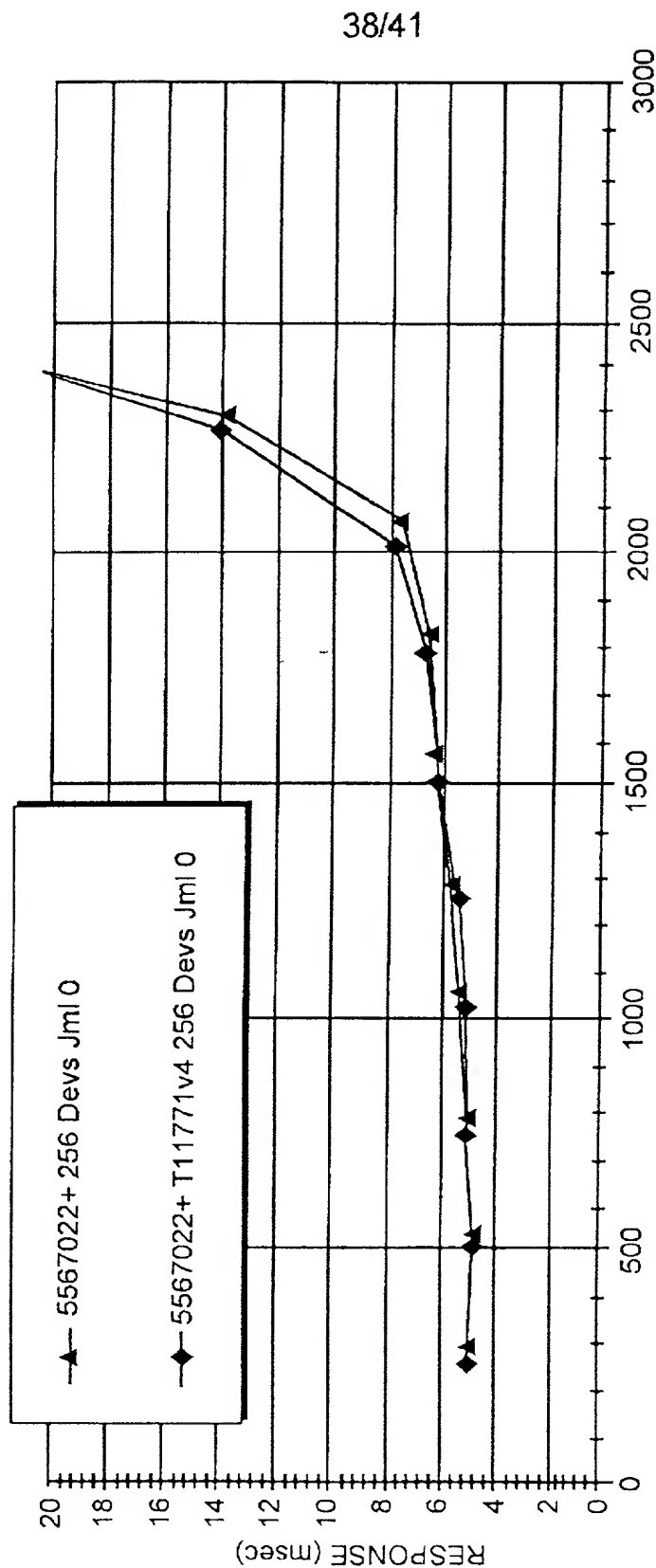
4K MIXED ENVIRONMENT
UNIFORM DISTRIBUTION OF I/Os
4K BLOCKS, 25% WRITE, 70% CACHE HIT



8430-18M48, SPLIT 6:1
96 PHYSICAL, 256 LOGICAL 3390-3
8GB CACHE
8 HOST CHANNELS

FIG. 24

BACK END WRITE TEST
27K BLOCKS, 100% WRITE, 30% WRITE HIT



8430-18M48, SPLIT 6:1

96 PHYSICAL, 256 LOGICAL 3390-3

8GB CACHE

8 HOST CHANNELS

FIG. 25

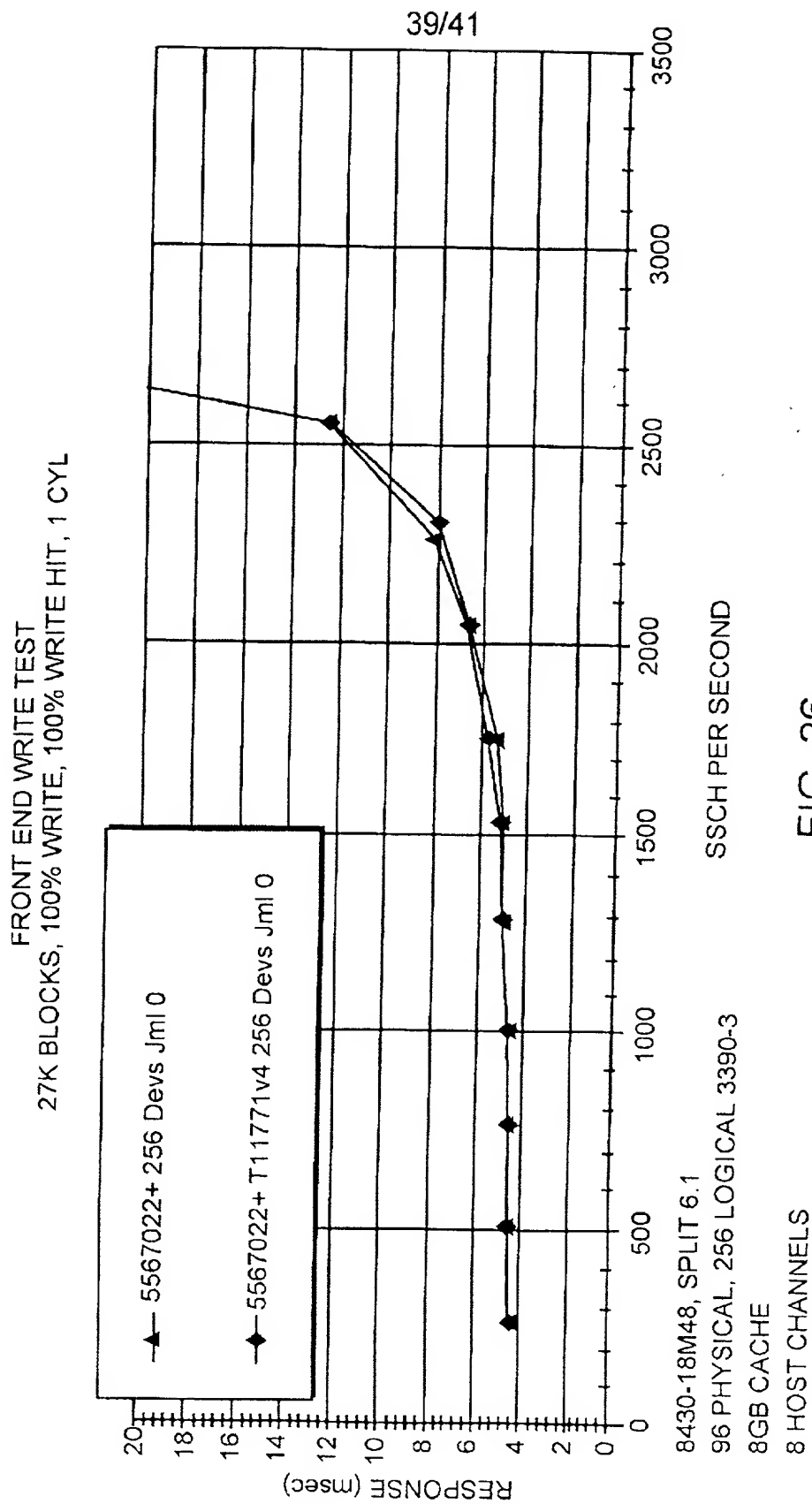


FIG. 26

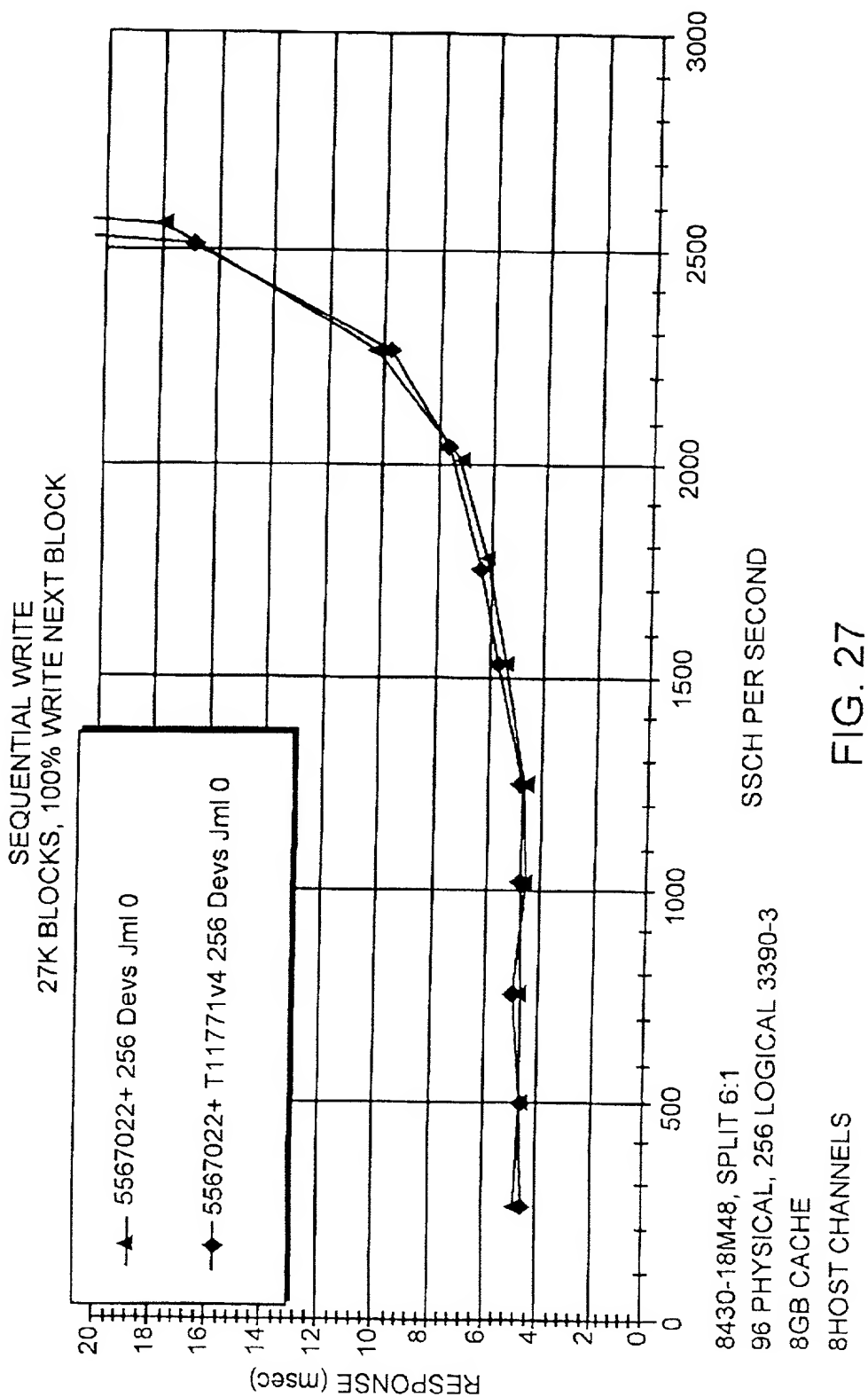


FIG. 27

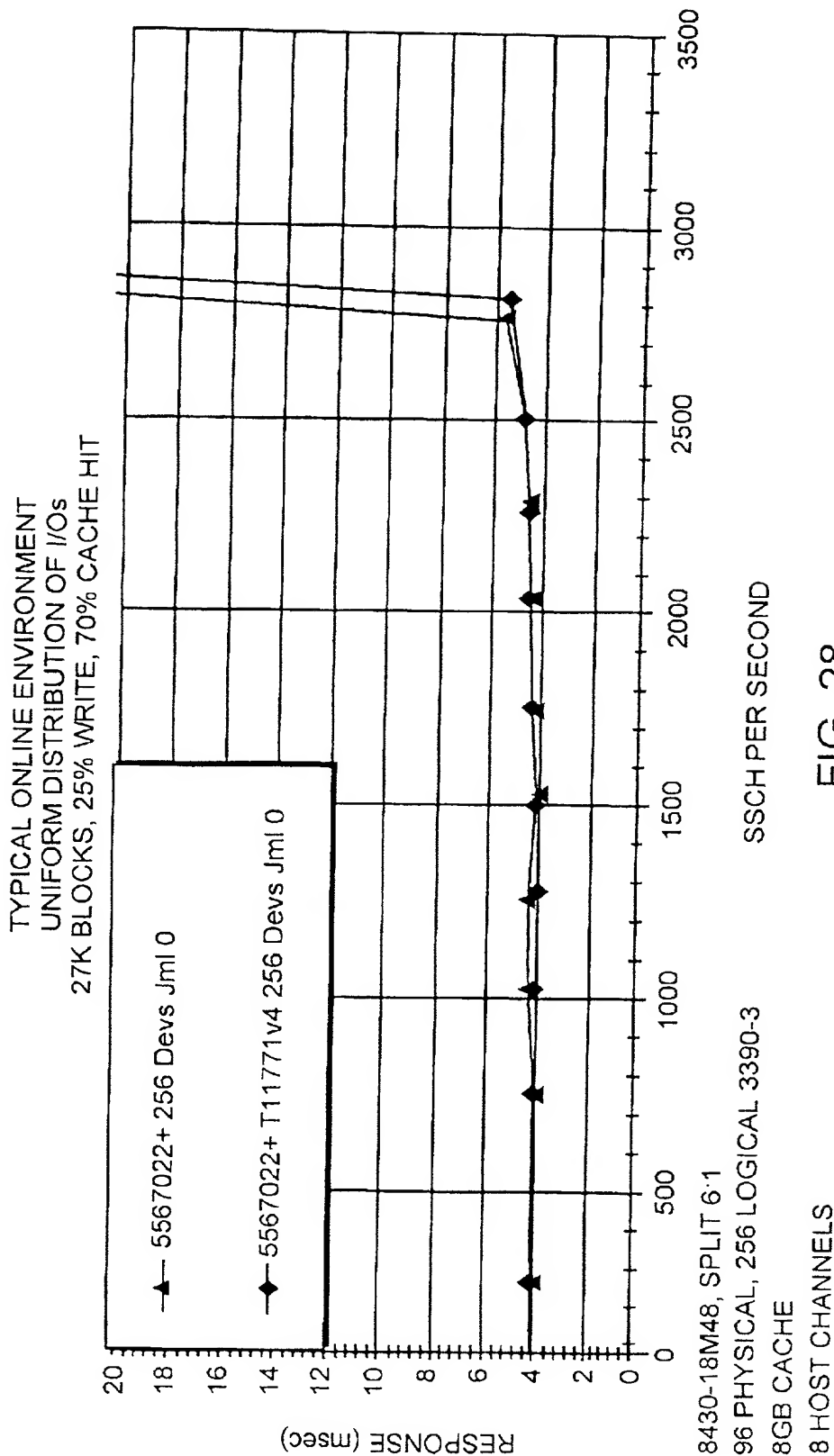


FIG. 28